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The Foundry Exhibition

It is high time that the real meaning of a foundry exhibition was cleared up. To the best of our knowledge, there has never been a "foundry" exhibition. There have been foundry equipment shows, with sometimes quite large sections devoted to the exhibition of castings and the technique of their productions. Others devoted to the transport industry, machine tools, laundries, public works and many other activities have often quite inadvertently made an interesting show of foundry products. Now the Engineering and Marine Exhibition incorporating the Foundry Trades' Exhibition, which opens at Olympia on August 28 and continues until September 13, is of outstanding interest to foundrymen because not only are there about 25 stands specially devoted to foundry equipment and supplies, but among the 400 exhibitors there are innumerable examples of castings functioning as component of machines. This exhibition is of long standing, yet despite existing conditions, the 200,000 sq. ft. of space occupied represents a 50 per cent. increase on the previous highest figure. It is housed in Grand and National Halls, but in another hall there is being held a quite separate exhibition devoted to the interests of Welsh industry. This should not clash, and those having time to spare will find this an additional incentive to visit Olympia.

In order to give service to our readers and advertisers, the FOUNDRY TRADE JOURNAL has taken space in Row F, Stand No. 13, where some members of the staff will constantly be available for consultation. The telephone number of the stand is Renown 3792. From a preliminary scrutiny of what is to be shown in the foundry equipment section, we can state that there is nothing very revolutionary. There has been a general streamlining of moulding machinery, associated with the introduction of push-button control, while increased use has been made of foot-pedal operated plant so as to leave free both hands for other work. When moulding machines first came on the market, they merely converted moulders into porters. With the advent of the servicing of the machines by conveyors, it was found that maintenance costs were high. Now a wealth of experience, while retaining the underlying features of the various types, has converted the machines into very reliable engineering productions. Since the beginning of the war, the foundry equipment industry has increased tenfold. In the period between the two wars, this country was a large-scale importer of foundry plant; now, when the rush of the reconversion of the home industry moderates, it is in a splendid position to export.

This exhibition should help the industry to ascertain from the foreign buyers the special requirements of the overseas markets. Especially must manufacturers turn their attention to the rapid provision of spare parts. In fact, stocks should be carried in certain of the more important centres, despite the facilities now available for despatch by air. The organisers of the exhibition have stated that "a very large contingent of overseas buyers will attend," and if exhibitors cannot supply their needs from "off the shelf," they can at least create good will by taking a live interest in the problems of the visitors. It must be confessed that some of the exhibitors have little or nothing for immediate sale—ourselves included—except for overseas; yet advantage must be taken of the opportunity afforded to create good will. Olympia, during the run of the exhibition, will indeed be a great clearing house of both national and international worth-while gossip.

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The Aachen Foundry Congress

Between two and three hundred foundrymen attended the 11th Aachen foundry congress held from July 23 to 26. It was presided over by Prof. Piwowarsky. The meeting was largely sponsored by the British Military Government. As the paper situation allows, we shall from time to time print abstracts of the papers presented. Among the most important was a paper by C. Adey of Burscheid, who dealt with the manufacture of cast iron with a spherulitic structure. The systematic production of such a structure will impart superior properties to cast iron, especially from the aspect of tensile strength, elongation and resistance to impact, as the graphite exists in its most favourable condition—*i.e.*, in the ideal spherical form. Basing his studies on the crystallisation of sodium phosphate and sodium thiophosphate, the author has applied his results to cast iron. Among his conclusions are:—(1) The molten mass must have a high degree of saturation owing to the high carbon and silicon content; (2) the rate of crystallisation is a determining factor; and (3) the iron must have a very low sulphur content so that the undercooling is not terminated prematurely.

Experiments were carried out on a series of irons carrying carbon contents ranging from 2.6 to 4.05 per cent. Where the casts carried a white fracture in the thinner sections, a short heat-treatment ensures a spherolitic structure. Piston rings, with a 3 × 5 mm. section, were heated at 900 deg. C. for a period ranging between 40 and 80 min. Ladle additions of Fe Si brought about a tendency to change eutectic graphite into the coarse primary form and the spherulitic type into eutectic graphite. The outstanding feature of the development is the securing of a structure having a high carbon content which combines a high order of strength with relatively good vibration damping capacity and freedom from notch sensitivity, even with high phosphorus content, if a marked degree of wear resistance is sought.

The Wetherill Vacuum Casting Process

After seven years' research, sponsored by the Wetherill Engineering Company, of Philadelphia, at the Armour Research Foundation, a continuous system of casting *in vacuo* has been successfully developed. Brake shoe heads cast in steel using this method have given a yield of 80 per cent. as against the normal 55 to 60. The claims made for this process are summarised as follows:—(1) Increased yield of good castings (any usual casting alloy) is obtained because of better control over pouring conditions; (2) permits redesigning to thinner sections due to the facility with which such sections may be run; (3) some improvement in yield is possible with certain castings because of metal draining out of the liquid runners; (4) reduces defects attributable to slag and to pin-holes and porosity.

This is the type of information with which we should like to have dealt more fully, but paper supplies nowadays seem to be especially reserved for Government publications and the pornographic Press.

Paragen Burners

Wild-Barfield Electric Furnaces Limited, Elecfurn Works, Watford, Herts., have sent us details of a system they have developed for the institution of controlled atmospheres in hardening furnaces. This happens to be of personal interest, as many years ago the late Mr. Victor Stobie asked us to re-harden a small gear from his car. In order not to burn the component during heating up, we maintained a smoky atmosphere by constantly introducing bits of bituminous coal. The next step was the installation of a tank of fuel oil above the furnace and allowing a fine stream to drip into the furnace. Finally, there was a little work done on the addition of hydrocarbons to town's gas. Then, owing to lack of time, the proposition was dropped. Where we failed, Wild-Barfield have succeeded through the use of paraffin. This is maintained under pressure, led by pipework to burners which vaporise the fuel and allow it to be burnt. Specimens of hardened alloy steels, as indicated by photomicrographs, show no scaling tendency during this process. The system is to be shown at the forthcoming foundry exhibition.

"*Enterprise Scotland*"

Trade visitors from all parts of the world will find a system in operation which will allow them to complete their work easily and quickly at the "Enterprise Scotland" Exhibition in Edinburgh. They can have a private view every morning for one hour before the general public is admitted. A trained staff with knowledge of the different sections will be available to answer questions and arrange contacts. Industrial experts from the Scottish Chambers of Commerce will also be available, aided by interpreters. The Exhibition, which is open from August 25 to September 30, is organised by the Council of Industrial Design, and will be held in the Royal Scottish Museum, Chambers Street, Edinburgh.

Increases in Examination Fees

The City and Guilds of London Institute have announced that, having regard to the increasing calls that are being made on the Department, and to the great increase in costs all round, the Institute has been compelled to increase the examination fees by approximately 45 per cent. over all. Revised fees on that basis have been introduced for the examinations of 1947.

The Foundry Exhibition

An unfortunate misprint crept into our issue of August 14 on page 6 of the advertisement section where it was stated by the advertisers, British Moulding Machines, Limited, that the Foundry Exhibition opened on August 18 instead of August 28. The advertisers associate themselves with us in apologising for any confusion this may have caused.

Graphite Formation in Grey Cast Iron*

By H. Morrogh and W. J. Williams
(British Cast Iron Research Association)

INTRODUCTION

All grey cast irons contain graphite and the characteristic properties of these alloys are largely dependent upon the amount and mode of occurrence of this phase. In grey cast irons, the formation of graphite is associated primarily with the solidification process. In malleable cast irons, graphite forms during, and as the result of, an annealing treatment. This Paper is concerned with the formation of graphite in grey cast irons and not with the process as it occurs during the annealing of a white iron to give a malleable iron. These two phenomena are not entirely disconnected, however, as will be seen later.

The full metallurgical potentialities of cast irons and pig irons will not be realised until the process of graphite formation is completely understood and controlled. Much progress has already been made in this direction, but there is still opportunity for considerable further investigation for many years to come. Cast irons are perhaps the most complex of alloys. They normally contain the elements carbon, silicon, manganese, sulphur and phosphorus, and others such as nickel, chromium, copper, titanium and vanadium are also liable to be present. In addition, the elements oxygen, nitrogen and hydrogen are usually found in cast iron. These elements need not be catalogued in greater detail in order to impress the complexity of the alloys and the difficulty of obtaining fundamental information about the changes occurring during solidification. Cast irons are also probably unique in their response to variations in rate of cooling during solidification. Studies of cast irons under equilibrium conditions are of little avail in understanding the commercial material.

In view of this complexity it is not surprising that many theories have been adduced to explain the various phenomena and anomalies which have been observed. The range of problems relating to graphite formation is so wide that it has rarely been possible for any one investigator or group of investigators to deal with them all in one research. This has led, not unnaturally, to a tendency for explanations to be developed which cover only a few of the details requiring explanation. In many cases a consideration of some of the omitted points would have demonstrated the very limited applicability of the suggested theories. It is the opinion of the present Authors that a stage has been reached in the study of graphite formation when it becomes an impelling necessity to consider all the known facts and observations together, with the end in view of developing a general theory to cover the whole field. An attempt has been made, in what follows, to set out as many as possible of the anomalies of graphite formation which require correlation, to discuss them and develop their interrelations in an endeavour to provide a basis upon which a general theory of graphite formation may subsequently be erected. In addition, the results of some of the authors' experiments are presented and related to the already existing information.

The Fe-C-Si System as Study Basis

Cast irons are essentially iron-carbon-silicon alloys, also containing varying amounts of manganese, sulphur and phosphorus as an invariable rule. When considering cast iron, reference is frequently made to the binary iron-carbon system. The limitations of this method of treatment are obvious, and it is far better to use the ternary iron-carbon-silicon system for the basis of discussion. However, cast irons differ in many significant ways from the alloys depicted by this ternary system. Equilibrium diagrams for the binary iron/iron-carbide system and the binary iron-silicon system are known with a fair degree of certainty. The ternary iron-carbon-silicon system is much less clearly understood even under conditions approaching equilibrium. A further complication exists in the fact that the ternary alloys, at least, exhibit a metastability anomaly which is of tremendous commercial significance. Under some conditions of cooling and composition, or by an appropriate thermal treatment, steels and cast irons have major microstructural phases consisting of graphite and solid solutions of carbon in alpha-iron (ferrite) and gamma-iron (austenite). On the other hand, with different conditions of cooling or composition, the major structural phases are iron carbide (Fe_3C, cementite) and the two solid solutions. In these latter cases the carbon is said to be in the combined form. It is generally assumed that iron carbide is a metastable compound and this has led to the postulation of the existence of two sets of analogous systems—iron-iron-carbide and the iron-iron carbide-silicon metastable systems on the one hand, and the iron-carbon (graphite) and the iron-carbon (graphite)-silicon stable systems on the other. In both cases the carbon is generally assumed to be in the same condition in the liquid alloys. It is probably not completely correct to consider iron carbide as a metastable compound, and it is preferably regarded as an unstable compound which, under certain conditions, has considerable persistence. Viewed in this light, iron carbide would not be expected to occur in any iron-carbon-silicon alloys if they could be cooled sufficiently slowly to permit equilibrium to be established.

If the idea of a metastable and a stable system is accepted as a working theory, it should be noted that the situation is further complicated by the fact that during cooling transformations at different stages in the cooling may occur, in any one alloy, according to either the stable or the metastable systems. For instance, with this concept applied to a pearlitic grey

* Paper presented at the Nottingham Conference of the Institute of British Foundrymen.

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cast iron, solidification may proceed according to the stable system with the formation of flake graphite and austenite, but this austenite subsequently transforms to pearlite according to the metastable system. As a general rule, rapid cooling tends to give the phases predicted by the metastable system and slow cooling to give the phases predicted by the stable system. Elements such as sulphur, tellurium, boron, chromium, molybdenum, manganese, etc., encourage solidification and subsequent transformations to occur according to the metastable system, and are therefore described as carbide stabilisers. Others may facilitate transformations to occur according to the stable system, for instance, silicon, nickel and copper. These elements are therefore known as graphitisers. No satisfactory explanation has yet been forthcoming which will explain the influence of these elements upon carbide stability. Many anomalous cases may be recorded in this context; for instance, titanium and zirconium themselves form very stable carbides, but they have little influence on the stability of iron carbide in cast irons; aluminium behaves as a graphitiser when present in small amounts (less than 2 per cent.), but as a carbide stabiliser when present in large amounts (6-9 per cent.); other elements such as cobalt and phosphorus do not appear to have any pronounced influence in either direction. The proximity of microstructural graphite to cementite also tends to cause it to be less stable, the effect becoming more pronounced the finer the graphite particles. In addition to these influences, the gaseous elements, oxygen, hydrogen and nitrogen, may also influence the stability of iron carbide.

In addition to the dual complexity briefly referred to above, a further complication exists in that iron-carbon-silicon alloys and cast irons, even when they contain graphitic carbon, may have this graphite distributed in one of two ways, or in a wide range of combinations of these two ways. In one case the graphite may occur in a lamellar form, conventionally described as flake graphite; in the other case the graphite occurs in a very much more finely divided form, variously referred to as supercooled, undercooled, reticular, eutectic-like, dendritic, etc. These two structures have been frequently illustrated in the literature, and they will be discussed in some detail in what follows. The mechanical properties of grey cast irons vary considerably, according to the form of the graphite, and it is therefore of considerable industrial importance to determine the factors governing which type of graphite will occur.

In much of the literature dealing with graphite formation, it is presumed that graphite can only exist in these two forms in "as-cast," that is, not heat-treated, cast irons. It is one of the objects of this Paper to present the preliminary evidence for the existence of other forms of graphite, including the nodular type, which hitherto has only been obtained by the heat-treatment of a white iron.

From what has been said so far in this introduction, an indication can be obtained of the wide field and complexity of the problem. As many as possible of the relevant points will be dealt with in detail in what follows. The same subject has been dealt with by the present Authors elsewhere[1] in greater detail, and for further information on any matters of detail it is suggested that reference be made to this source.

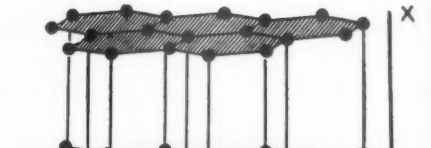


FIG. 1.—SHOWING THE ARRANGEMENT OF THE CARBON ATOMS IN A GRAPHITE CRYSTAL.

In the course of the Authors' experimental work, a detailed study has been made of graphite formation in nickel-carbon and cobalt-carbon alloys. The relevance of this investigation to the problem of graphite formation in cast iron may not be immediately apparent. It is possible, however, to obtain useful information about a given series of alloys within a given system by the study of analogous systems of other alloys. This method has been applied here with useful results, and the ideas upon which this line of investigation was based are thoroughly dealt with in the appropriate section of this Paper.

The Nature of Graphite in Cast Iron

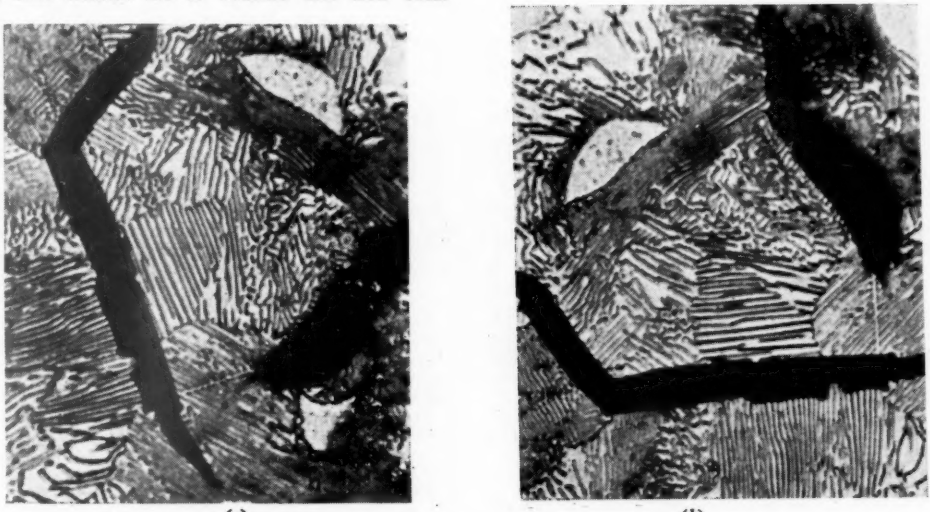
Before considering the mechanism of graphite formation, it is well to consider the nature of the graphite phase itself, what is known of its properties, and the metallography of the graphite flakes occurring in cast irons. Flake graphite and nodular graphite are known to be almost identical with both natural and synthetic graphite. It is, in many ways, a unique phase in ferrous alloys, and it owes its special characteristics to its crystal structure. When considering the growth of graphite crystallites in cast iron, it is well to bear this crystal structure in mind. Graphite is an allotropic form of carbon (diamond is another) in which the atoms are arranged in a series of parallel sheets, in each of which they lie at the corners of a set of plane regular hexagons. The sheets are so superimposed that only one-half of the atoms in any one sheet lie vertically above the atoms in the sheet below. The atoms in alternate sheets lie vertically above each other. This structure is clearly illustrated in Fig. 1. This atomic pattern is conventionally referred to as the "layered hexagonal structure."

It will be seen that the distance between any pair of atoms in the sheets is very much less than the distance between successive sheets. The actual distance between the atoms in the sheets is 1.42 Å ($1Å=10^{-8}$ cm.), and the distance between sheets of atoms is nearly 2.6 times this value. The great disparity in these two distances shows the forces binding the atoms within the layers to be much greater than the forces binding the layers together. Distortion or mechanical stressing of a graphite crystal causes, as the result of this weak inter-layer binding, the displacement of one part of the crystal relative to another by a process of slip along the planes of densely packed atoms. Slip along these planes occurs very readily, and is responsible for the excellent cleavage and the remarkable lubricating properties of graphite. The planes in a graphite crystal containing the sheets of closely packed atoms, that is, the planes parallel to these sheets, are referred to for convenience as the basal planes, and thin slices of graphite with major surfaces parallel to these planes are described as basal sections of graphite.

Graphite flakes in cast iron are essentially basal sections of graphite. In the case of kish (or hypereutectic) graphite, the flakes may be almost perfect sections, but other forms of flake graphite are basal sections which are generally distorted in all directions, and they may be arranged in complex shapes and groupings. Graphite flakes usually appear on the surface of microspecimens as long thin lamellæ, and it can be shown by examination under polarised light that these lamellæ are so oriented that their basal planes are approximately parallel to the visual length of the flakes. Thus the longest direction of a graphite flake is approximately at right-angles to the direction XX_1 in Fig. 1. The polished surface of a cast-iron microspecimen is a random section through a large number of randomly oriented graphite flakes, and therefore the angles between the basal planes and the surface of a microspecimen will have a statistical distribution covering all angles between 0 and 90 deg. When the angle between the basal plane of a graphite flake and the surface of the microspecimen is 0 deg., the basal plane is parallel to the polished surface. The probability of this condition occurring is very low and when it does occur it is impossible to polish the flake because of the facility with which exfoliation occurs.

Due to its crystal structure, graphite is anisotropic, that is, its properties vary according to the orientation of the crystal being tested. Reference has already been made to the marked tendency to slip and exfoliation along the basal planes—this is a manifestation of this anisotropy. The anisotropy of graphite is also revealed by its optical properties. In sections parallel to the basal planes, graphite has a metallic appearance with a high reflectivity. Nipper[2 3] has shown some very interesting photographs of basal sections of kish graphite, demonstrating this high reflectivity and showing a pattern of hexagonal outline.

When irons of coarse flake graphite structure are fractured, a bright crystalline fracture is obtained



(*a*) (*b*)

FIG. 2.—ILLUSTRATING THE REFLEX PLEOCHROISM OF GRAPHITE: (*a*) WITH GRAPHITE FLAKE IN POSITION OF MINIMUM ABSORPTION; (*b*) AFTER ROTATING THE STAGE THROUGH 90 DEG. WITH GRAPHITE FLAKE IN POSITION OF MAXIMUM ABSORPTION. PLANE OF POLARISATION OF THE INCIDENT LIGHT IS NORTH-SOUTH. ETCHED IN PICRIC ACID. × 2,000.

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because failure has occurred, for the most part, along the graphite flakes, and these in turn have failed along their basal planes, leaving these highly reflective planes exposed on the fractured surface. All the cut surfaces of a graphite crystal other than the surfaces parallel to the basal planes have a typical non-metallic appearance with poor reflectivity and marked optical anisotropy. These surfaces are those normally visible when graphite flakes are observed in a polished microspecimen.

Graphite flakes in cast iron can be polished and the optical anisotropy can be studied by means of the polarising microscope.[4] The first manifestation of this optical anisotropy occurs when polished graphite flakes are examined microscopically using plane polarised light. This condition normally exists in all metallurgical microscopes without any extra equipment. It is found that the "colour" of a given graphite flake will vary, according to its orientation in the microspecimen, from light brown to black and when the stage of the microscope is rotated through 360 deg. it will change from light brown to black twice, and from black to light brown twice.

This phenomenon is known as reflex pleochroism and it provides a means by which the internal structures of graphite flakes may themselves be studied. It is found that the appearance of a graphite flake depends upon its orientation with respect to the plane of polarisation of the incident plane polarised light such that when the plane of polarisation is at right-angles to the length of a graphite flake, maximum absorption of light will occur and the flake will appear black, and when the plane of polarisation is parallel to the length of the flake, minimum absorption of light will occur and the flake will appear light brown. This phenomenon is illustrated in Figs. 2A and 2B. Due to the reflex pleochroism of graphite it has been possible to show that many graphite flakes have complex needle-like structures internally and, in fact, many graphite flakes are not single crystals but aggregates of interlacing crystallites.

A typical example of these complex structures is illustrated in Fig. 3 and they have been described and illustrated in greater detail elsewhere[1,4] by the present investigators. These structures are revealed with this clarity by virtue of the fact that the small crystals of graphite, being variously oriented amongst themselves, will have various orientations with respect to the plane of polarisation of the incident light, and hence will show various degrees of light absorption. The significance of these complex structures is not yet understood.

It is convenient here to refer to a form of graphite which will be instanced in many occasions in the remainder of this paper, namely, the spherulitic nodular type. Normally this type of graphite is obtained by the heat-treatment of a white iron containing free iron sulphide,[5] and in this context it is outside the field covered by this paper. However, in this paper the preliminary work will be described which led to the

FIG. 3.—SHOWING THE COMPLEX INTERNAL STRUCTURE OF A FLAKE OF KISH GRAPHITE. UNETCHED × 2,000. PLANE OF POLARISATION OF THE INCIDENT LIGHT IS NORTH-SOUTH.

demonstration of the feasibility of the production of nodular graphite of this type in cast irons in the as-cast state without any heat-treatment. A typical spherulitic nodule is illustrated in Fig. 4. Spherulites are characterised by the occurrence of a large number of radially oriented crystallites growing from a common centre or nucleus. The spherulitic structure of such graphite nodules is made clearly visible again by reason of the reflex pleochroism of graphite. By the use of the polarising microscope it can be shown that the general orientation of the graphite crystallites in the graphite spherulites is such that their basal planes are usually at right-angles to the radii of the spherulite. Spherulitic structures are well known to the mineralogist, but to the knowledge of the present authors graphite spherulites are unique in metals and alloys.

The Solidification of Cast Irons

Before proceeding to discuss the anomalies of graphite formation it is useful to make a statement of some of the more generally accepted facts relating to graphite formation in cast irons. The Authors are well aware that to the extremely critical mind there is little fundamental information about this process which can be said to be generally accepted. However, a number of points can be made and accepted as a working basis for the consideration of the problems of graphite formation, provided they are not accepted as axioms.

In describing the solidification of cast irons it is usual to refer to the iron-carbon equilibrium diagram, and though this may serve a useful practical function, it does not suit our present purpose. A better approximation to the truth is obtained if reference is made

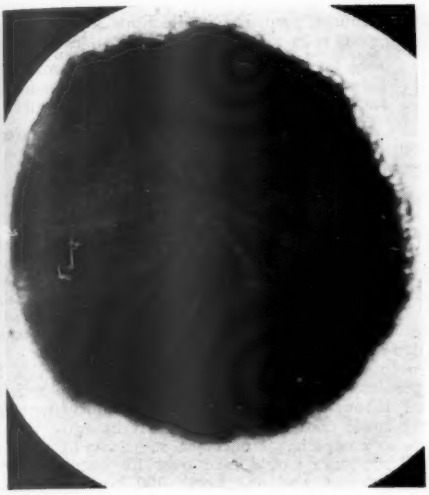

FIG. 4.—A TYPICAL SPHERULITE OF GRAPHITE. UNDER PLANE POLARISED LIGHT. UNETCHED. × 1.500.

to the ternary iron-carbon-silicon system. Sufficient information is available upon this system[6, 7, 8, 9] for it to serve as a rudimentary basis for discussion. However, in all cases with one exception[8] the metastable carbide phase is indicated in the system at the solidification temperature and this is manifestly incorrect, especially when dealing with silicon contents in excess of 1 per cent.

The binary stable iron-carbon system can be considered as a eutectiferous system—the eutectic, occurring in all compositions with more than about 1.7 per cent. C, consisting of a solid solution of carbon in gamma iron (austenite) and graphite and having a composition of approximately 4.3 per cent. carbon. Binary alloys with less than 4.3 per cent C, the hypo-eutectic alloys, solidify by the deposition of dendrites of austenite followed by the eutectic crystallisation at about 1,130 deg. C. Binary alloys with more than 4.3 per cent. C the hyper-eutectic alloys, solidify by the primary crystallisation of kish graphite, followed by the crystallisation of the eutectic. (It should be noted here that these remarks are only intended to apply to solidification giving flake graphite, in contradistinction to solidification giving undercooled or supercooled structures, the formation of which is more complex, as will be shown later.)

In the ternary iron-carbon-silicon system, the representation of which must be three-dimensional, the eutectic depression on the binary liquidus curve becomes a trough curving gradually towards the iron-silicon side of the solid diagram. The bottom of this trough indicates the formation of a binary complex of austenite and graphite, the carbon content of which decreases with increasing silicon. This binary complex apparently possesses many characteristics of a true binary eutectic and is usually referred to as a eutectic. It should be noted, however, that, following the phase rule, this binary complex may solidify over a range of temperature with varying composition.

To avoid confusion, this binary complex will be, hereafter in this paper, referred to as the eutectic, but the limitations of this nomenclature should be borne in mind. The effect of silicon upon the carbon content of this eutectic has been closely investigated[6] and may be represented for silicon contents of up to 3 per cent. by the formula:—

$$\% \text{ C in eutectic (or binary complex)} = 4.23 - \frac{\% \text{ Si}}{3 \cdot 2}$$

Iron-carbon silicon alloys or cast irons (of low phosphorus content) will be described as "hypo-eutectic" when they have more carbon than $\left(4 \cdot 23 - \frac{\% \text{ Si}}{3 \cdot 2}\right)$.

For flake graphite structures the eutectic has an "un-eutectic-like" appearance and many find it difficult to accept as the product of eutectic crystallisation on this fact alone. For hypo-eutectic alloys and the primary austenite dendrites may be columnar or equiaxed according to the conditions of cooling when they form, that is, according to whether they crystallise under the influence of a sharp temperature gradient or not. The eutectic solidifies on a spheroidal crystallisation front with the simultaneous crystallisation of austenite and graphite. If this austenite and graphite complex was a true eutectic it should be possible to obtain a structure without any evidence of primary austenite dendrites or primary kish graphite by the solidification of an alloy with $\% \text{ C} = 4.23 - \frac{\% \text{ Si}}{3 \cdot 2}$. In no cases have the present investigators observed this and in all the samples which have been examined some evidence of primary crystallisation was apparent. It may, of course, be argued that the presence of primary crystallites is brought about by undercooling and this point will be dealt with in more detail later.

The fact that eutectic crystallisation proceeds on a spheroidal crystallisation front tends to influence the pattern of the resulting eutectic graphite flakes which may be disposed radially within each eutectic cell, giving rise to the well known cluster or whorl formations. All the eutectic cells are allotriomorphic, taking their final shape as the result of contact with neighbouring cells and the availability of space between the primary dendrites. The perfection of the eutectic cells depends to a large extent upon the free space between the primary dendrites. In all hypo-eutectic grey cast irons, the graphite forms after, and hence between the primary dendrites, and in this sense all the graphite in such irons is interdendritic. In low carbon cast irons, the space between the primary dendrites is relatively small and hence the eutectic cells are imperfectly formed and the disposition of the graphite flakes is dictated more by the pattern of the dendrites than the eutectic cells and the graphite flakes clearly outline the austenite dendrites.

(To be continued.)

Planning the Output of the Patternshop*

By A. G. Squires

The practice of doing jobs in rotation, modified by forwarding those jobs described as being "urgent" is commonly used in spite of several drawbacks; this is understandable, as it upholds the principle of "first come, first served." It is the purpose of this Paper to indicate the shortcomings of this procedure and to suggest a workable alternative.

The objection referred to is that some patterns take an abnormal time to complete in relation to the amount of work involved in making them: for example, if there is already a "load" of one month's work on the shop and a pattern which will take about four hours to make is ordered, it will be over a month before it is delivered, approximately a time lag of forty times its value in man-hours. From the customer's viewpoint, every pattern finished means more castings and more completed jobs. From the patternmaker's angle, every job finished in a reasonable time means another satisfied customer, whether it be an actual "customer" or another works department.

Classification of Jobs

The object of this proposal is to complete as many jobs in the quickest time. Classify all types of jobs done in the shop, the total work of which will come under the broad heading of "Patternmaking." There will probably be two main classes—new patterns, and alterations and repairs to patterns. The first group can be further divided into two sections—those needing the best grade of labour, and others within the scope of the average workman. This makes three groups of work, and these must each be further subdivided into three groups:—(1) Jobs estimated to take up to 10 hours; (2) jobs worth from 10 to 50 hours; and (3) jobs likely to take over 50 hours. Thus, firms who make only new patterns will have six classes of jobs, and those who also handle repairs will have nine. This may be slightly increased when some specialised work, such as loam moulding, is handled in any quantity. Thus, with a typical works patternshop having nine classes of patternwork and employing 20 patternmakers, it should be possible to employ two men on each class of job, but experience indicates that the following allocation of labour would be better:—

Repairs and Alterations.—Three men, with one of them set aside to deal with all jobs worth up to ten hours' labour. This will keep "odd jobs" under control, and prevent the accumulation of a pile of small patterns.

New Patterns

Jobs needing first-class labour.—The amount of labour available for this work will be limited and will, of course, control the allocation. The suggested arrangement is to allow for the following:—

Jobs up to 10 hours ...	...	1 man
Jobs up to 50 hours ...	...	1 man
Jobs over 50 hours ...	...	2 men

Finally, there is the type of work suitable for average labour:—

Jobs up to 10 hours ...	...	2 men
Jobs up to 50 hours ...	...	5 men
Jobs over 50 hours ...	...	6 men

It must be clearly understood that the arrangement of labour employed must fluctuate and must be controlled by the type of work and the quality of labour available. The foregoing example is intended to show that, with a mixed load, all classes of jobs can be kept moving and that a few big jobs need not unduly hold up work on the many smaller ones.

Compare the method usually followed with this suggestion and it will be seen that a job worth four hours' labour (and which ought to be finished within a week) could take up to forty times its value in man-hours to complete. Under the same conditions a job worth 50 hours would take over five weeks, or nine times its value, and one worth 200 hours would take three times its value in man-hours to deliver.

The object of the proposed scheme is to complete all work in a time proportional to the working hours involved, and under this scheme, jobs taking up to ten hours would be cleared within a week, a saving of four weeks. Jobs worth 50 hours could be cleared within three weeks, a saving of over two weeks, whilst one worth 200 hours would take perhaps another month longer than before.

Bearing in mind the probability that the proportion of smaller jobs would be in the majority, the benefits of this arrangement are considerable, and, as in the example, all jobs would be cleared in about four times the time value of the job, the task of giving delivery promises is simplified and can be determined by estimating the working hours involved in doing the work and multiplying the factor determined by the current load.

Larger shops employing more men can be more easily manipulated as the proportion of men to be kept on the smaller jobs need not be so great; a few men kept on the job can keep things under control, whereas in very small shops such detailed allocation is not possible, although the principle of setting a time limit on jobs, proportional to their value, can still be followed.

The indirect advantages are considerable where this method is followed; it compels shop foremen to place a time value on every job, so that when a delivery promise has to be given he is in a strong position to give an accurate forecast because the continual practice of estimating (and subsequent comparison with "time taken") will improve his ability in this direction. He will also be kept up to date in his knowledge of the output (and the consequent value) of his men, the determination of the actual delivery date being, as already stated, merely a matter of simple arithmetic.

*An entry for a Short Paper Competition, organised by the Birmingham, Coventry and West Midlands Branch of the Institute of British Foundrymen.

Some Notes on the Surface Drying of Moulds*

By A. Cracknell and F. Cousans

(*Concluded from page* 347)

Air Drying of Moulds

This part of the work was carried out to find to what extent air-drying occurred in moulds left to stand over week-ends prior to being skin dried.

Procedure.

Here again 18 in. square boxes were selected for the experiments and rammed with both surfaces flat, the unit facing sand being used throughout. The upper surface was usually painted with mould paint, but on occasions was left unpainted. The initial work was directed towards finding how the moisture content of the surface ½ in. of the mould varied with respect to time and to establishing what changes take place, within the mould, by means of moisture gradients.

Comparison was also made between the rates of air drying of sands of different permeabilities, but under the same atmospheric conditions. For this purpose, a sand consisting of 5 per cent. bentonite, 5 per cent. moisture and 90 per cent. King's Lynn red was made up and compared with a box rammed up from the ordinary facing sand mixture. Moisture gradients were determined in both moulds during air drying. A further comparison was made to find if liquation had any effect on the rates of air drying (*i.e.*, to find if the upper surface of a mould air-dried more slowly than the bottom surface, provided that the atmosphere was allowed to circulate freely over both of them).

Results.

Moisture determinations on the surface layer of a mould, left to stand under shop conditions of temperature and humidity, show that the moisture drops rapidly to 1 per cent. and then remains very nearly constant. This should be compared with the ageing of moulds in which the surface moisture rises up to 1 per cent. and then remains fairly steady.

Determinations of moisture gradients during air drying, show that the condition is analogous to that of ageing of skin-dried moulds, except that during the first 20 hours the moisture content falls to 1 per cent. instead of rising up to 1 per cent. After this period of time, the moisture content of the surface remained constant, the moisture continued to dry out from further back in the mould and again, the position appears to be that the rate at which the moisture evaporates from a surface concentration of 1 per cent. just balances the rate at which it creeps forward from the back of the mould.

Since both air dried and skin dried moulds maintain 1 per cent. moisture at their surface, the drying properties of a mould are not radically altered by skin drying, or there would be a difference between the moisture concentrations at the surface of the two types. A comparison was made between the air drying properties of two moulds made from sands of different permeabilities and which were dried under the same atmospheric conditions. The less permeable moulds maintained a slightly higher moisture content at the surface. This may be due to one, or both, of two things:—

(*a*) The moisture does not evaporate as quickly from the surface layers of a low permeability mould, or

(*b*) the moisture creeps forward more quickly in the less permeable mould than the permeable one.

If the latter were the case, the air drying would be much more pronounced in the case of the less permeable mould than the permeable one, because of the higher surface concentration of moisture and, therefore quicker rate of evaporation. Also, if the rate of evaporation is to be a function of permeability, then evaporation cannot take place merely at the air-sand interface, but must depend somewhat upon penetration of the atmosphere into the surface layers of the mould.

The third section of this part of the investigation indicates that, whichever way up a mould is placed, provided that the atmosphere has free access to the surfaces, then the moisture will evaporate from those surfaces at the same rate. It should be noted that a surface dried at a fairly high temperature, *i.e.*, skin dried, appears to have different properties from those of a corresponding air-dried mould with a similar moisture gradient, but it has not been found possible to assess this factor quantitatively. It may be that this may prove decisive in any attempt to cast air-dried moulds in place of skin-dried moulds. Fig. 17 shows typical results.

Further Work on the Skin Drying of Moulds

Due to changes in shop practice, the apparatus for drying moulds by hot air became available for more detailed work on experimental moulds. Thus, it was possible to effect a survey (within limits of the apparatus), of independent variations in the volume and temperature of the drying air.

Procedure

During this series of experiments, the moulds (18 in. square by 6 in. deep, rammed flat and made from unit sand) were mounted on a bogie, so that their position relative to the hot air duct was nearly constant, a condition not achieved during earlier experiments. For purposes of taking samples from the surface for moisture determinations, the bogie was pulled out from under the duct for a short period of time (approximately 15 to 20 secs.). Two Pt.-Pt.-13 per cent. Rh. thermocouples were inserted in the mould, one at approximately $\frac{1}{16}$ in. from the surface and the other

* A Paper presented at the Nottingham Conference of the Institute of British Foundrymen (abridged).

Surface Drying

at 1 in. from the surface of the mould. The purpose of these couples was three-fold:—(1) To find the temperatures attained by the surface of the mould; (2) to gain some idea of the extent of the thermal gradients in the experimental moulds, and (3) to find if the temperature of the surface of the mould varied directly with time or if it increased more rapidly when the moisture had been dried out of the surface layers.

The e.m.f.s. generated by the thermocouples, were measured by means of a vernier potentiometer. So that as near a complete picture as possible might be obtained during this part of the work, the following data were collected:—

(1) Properties of the moulding sand used.

(2) Dimensions of the box used (similar boxes were used throughout) and the weight of sand used in filling the box—to check the consistency of ramming.

(3) The volume of air per minute delivered from the skin dryer.

(4) The temperature of the air from the skin dryer.

(5) The moisture gradients in the mould immediately before and after drying and at some time during ageing (usually after about 20 or 40 hours), and

(6) The temperatures at the surface and at one inch from the surface and the moisture content of the surface ¼ in. were noted during the drying period.

Detailed data are set out in Table I.

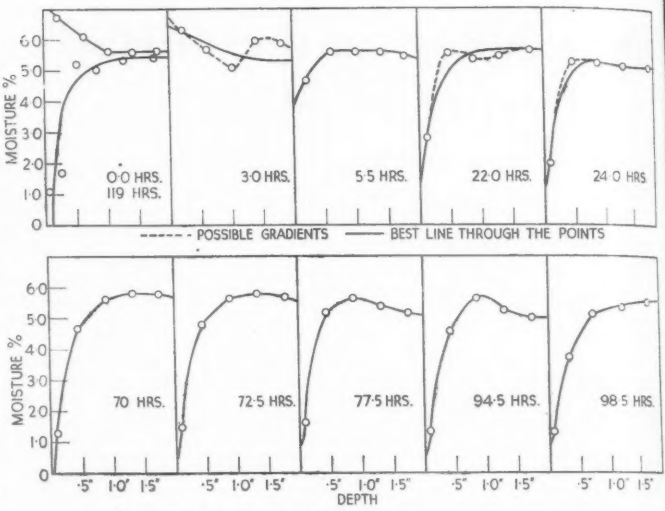

FIG. 17.—MOISTURE GRADIENTS DURING AIR DRYING.

Box, 18 in. sq. × 6 in. deep; weight of sand, 138 lb.; properties of sand, H_2O 5.6 per cent., G.C. 5.2 lb., P 200; mean humidity, 65 per cent.

Figures have been obtained for the different drying times taken by:—(1) Keeping the temperature of the air stream nearly constant and varying the volume of air, and (2) keeping the volume of air constant and varying its temperature. An example of the figures obtained is indicated in Fig. 18.

As can be seen from the moisture gradients taken immediately after drying, there is quite an appreciable difference in the quantity of moisture dried out in each mould, bringing to light further variables in any scheme of skin drying. This is probably the reason why the

TABLE I.—*Details of the Moulds, Sands and Drying Conditions in the Test Results.*

Mould No.	Drying conditions.		Properties of sand.					Atmospheric conditions.	
	Volume of air per sq. ft. per min.	Temperature of air.	Rammed density.	H_2O per cent.	Permeability.	Green compression.	Flowability.	Relative humidity.	Shop temperature.
	Cub. ft.	Deg. C.	Lb. per cub. ft.					Per cent.	Deg. C.
A. 2	200	210	117	5.0	160	7.9	85	69	13
A. 3	200	160	114	5.0	160	7.9	85	63	14
A. 4	200	110	119	6.0	160	7.9	86	68	12
B. 1	133	260	114	5.5	170	7.5	85	75	13
B. 2	133	210	123	5.7	200	8.4	85	65	15
B. 3	133	160	118	5.5	170	7.5	85	70	14
B. 4	133	110	114	5.4	180	7.5	87	69	8
C. 1	89	250	114	5.4	180	7.5	87	59	10
C. 2	89	210	116	5.5	180	7.9	86	70	9
C. 3	89	160	113	5.5	180	7.9	86	64	9
C. 4	89	110	115	5.6	170	7.7	87	76	7
D. 1	67	265	113	5.7	160	7.5	87	84	7
D. 2	67	210	114	5.7	160	7.5	87	78	9
D. 3	67	160	111	5.3	180	7.9	85	70	9
D. 4	67	115	116	5.2	150	9.9	85	71	9

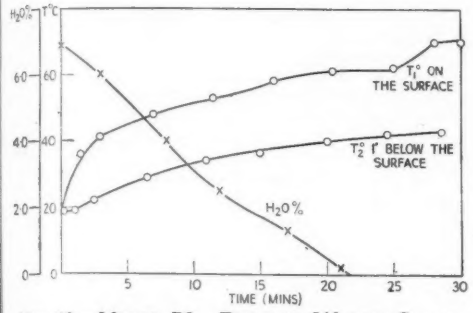

FIG. 18.—MOULD B2. DRIED AT 210 DEG. C. AND 300 CUB FT. PER MIN. (TOTAL VOLUME).

drying times, at constant volume or temperature, do not show as linear functions of temperature or volume respectively. If the graphs be arranged in order of decreasing volumes from left to right, and downwards in order of decreasing temperatures, definite trends can be seen, which indicate that higher temperature and volume of drying air make for quicker drying, but it should be borne in mind that, if the temperature of the air is excessive, there is a greater tendency for the surface of the mould to spall.

Since it is possible to achieve adequate temperatures in the mould by using a high "thermal input" (*i.e.*, a high volume of air at a relatively low temperature) instead of getting the same thermal input from a low volume of air at a very high temperature, then the undesirable features of high temperature air can be avoided, and, at the same time, the mould surface be raised to a high enough temperature for some "baking" to occur. Non-functional differences in temperature gradients for similar thermal inputs also indicate that a rigid mathematical control of the skin drying process, though greatly to be desired, may be very difficult to achieve in industrial practice.

Condensation of moisture from the products of combustion of the coal gas on to the surface of the cold mould has been observed on several occasions and has brought to light a further variable.

The temperatures, indicated by the thermocouples in the surfaces of the moulds, show that the temperatures at these points increase very rapidly at first and then tend to flatten out. At some stage during the remainder of the drying period, they again begin to rise, but this change does not appear to correspond with any particular moisture content in the mould and cannot, therefore, be used as a controlling factor for the skin drying process.

An examination of the moisture gradients taken during ageing, confirms the previous statement that after skin drying the moisture does not strike back but continues to air-dry from deeper layers of the mould. In fact, it would almost appear that a distinct advantage might be derived by leaving the moulds to air dry for a period after skin drying, provided that the properties of the surface are not impaired by a 1 per cent. moisture content. Fig. 19 is typical of the curves obtained.

Ageing of Standard Dried Samples

(1) Under Shop conditions; (2) over water, *i.e.*, for maximum possible atmospheric humidity; (3) with one face in contact with water.

(1) Eight standard samples (2 in. high x 2 in. dia.) were made (3 rams of standard rammer). These were first dried in a core oven and then left to stand in an exposed place in the moulding shop. The moisture content of the surface $\frac{1}{8}$ in. was determined periodically, using a "Speedy" moisture tester. To ensure that the drying was complete, the moisture content of

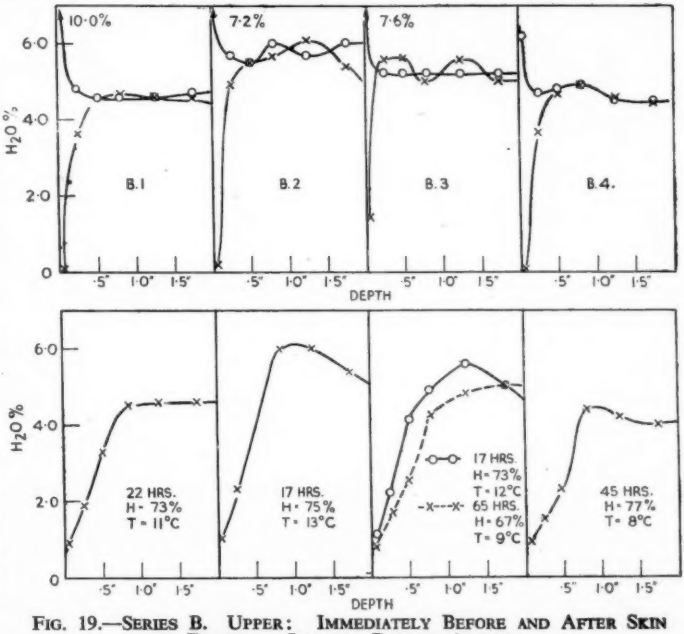

FIG. 19.—SERIES B. UPPER: IMMEDIATELY BEFORE AND AFTER SKIN DRYING. LOWER: DURING AGEING.

Surface Drying

the first sample was determined on a 50 gr. sample using a hot air dryer.

The results obtained are shown below in Table II.

(2) and (3). Dry samples were placed inside a can in the bottom of which was a little water. Five of the samples were placed on a ledge about 4 in. above the water and the other five were placed on a second ledge which was covered in blotting paper, the edges of which dipped into the water.

Experiment (2)

The moisture contents of the surface and middle of the samples on the top ledge were determined periodically. The results obtained are shown below:—

Time (hours) ..	17.0	65.0	71.5	89.0	103.5
Moisture (surface) ..	0.0	0.7	0.5	0.8	1.1
,, (centre) ..	0.0	0.7	0.5	0.8	1.1

Experiment (3)

The moisture gradients of the upper portions of the samples on the lower ledge were determined. Complete moisture gradients were not possible as the lower halves of the samples were very wet and collapsed very easily. The results are shown below:—

Time (hours) ..	17	65	71.5	89	103.5
H_2O per cent. (surface), $\frac{1}{4}$ in. ..	0.2	0.9	1.0	1.1	1.4
$\frac{1}{2}$ in. ..	0.2	1.0	1.0	1.1	1.4
$\frac{3}{4}$ in. ..	0.3	1.0	1.1	1.1	1.4
$\frac{7}{8}$ in. ..	0.4	—	1.2	1.2	—

These figures show that only under the worst possible conditions (*i.e.*, almost 100 per cent. relative humidity) does any appreciable quantity of moisture go back into a mould during the first 20 hours after drying from the atmosphere, thus confirming the previous view that the 1 per cent. moisture at the surface comes from the inside of the mould.

Conclusions

(1) It is not necessary for the surface of a mould to reach 100 deg. C. for the drying of the surface to be accomplished in a reasonable time.

(2) Skin dried moulds are being cast satisfactorily with the moisture content of the mould reaching its original value a little over $\frac{1}{2}$ in. from the surface. The principle purposes of skin drying are not only to remove moisture from the mould but also to harden the surface of the mould.

(3) If the mould is skin dried with air at a temperature greatly in excess of 300 deg. C. the surface layer of the mould forms an easily broken shell.

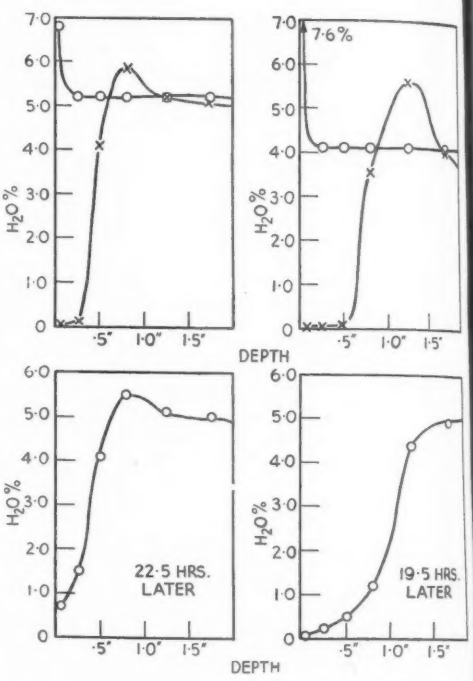

FIG. 20.—TORCH DRYING OF MOULDS. LEFT: DRIED FOR 4 MIN. RIGHT: DRIED FOR 6 MIN.

(4) To avoid the undesirable effects of spalling and maintain reasonable drying periods, it is necessary to dry the mould using a high volume of air with a moderate temperature.

(5) If a mould be left to stand after being skin dried, it continues to lose moisture.

(6) Moulds left to stand in the shop air dry very rapidly during the first twenty hours and approach the condition, in so far as moisture gradients are concerned, of skin dried moulds which have been left to stand after being dried. The properties of such an air dried surface have not been assessed quantitatively, but they appear to be such as to prohibit their use for making castings.

TABLE II.—*Moisture Content near Surface of Standard Samples*

Time (hours) ..	0	2.5	5.0	7.75	25.0	27.0	48.0	72.5	120.5
Moisture per cent.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5
Humidity per cent.	55	47	42	39	60	—	69	64	76

(7) The rate of air drying of a mould appears to be an inverse function of the permeability.

(8) The use of a fixed skin temperature as a means of controlling the skin drying process in order that uniform results might be obtained is not possible.

(9) Skin dried moulds left to age for short periods can be used satisfactorily. No deleterious effects such as pin-holes, scabbed surfaces, etc., have been experienced.

Acknowledgments

The authors wish to express their appreciation to the Directors of Catton & Company, Limited, for their kind permission to publish this first part of an investigation. Their thanks are also due to the foundry staff and moulders for their help and interest. It is hoped to continue this work and to submit further reports in due course.

ADDENDUM

Torch Drying of Moulds

In these experiments, 18 in. square by 6 in. deep boxes were rammed up with the unit sand with both surfaces flat. The upper surface was painted with mould paint. So that this work might be kept in line with former experiments, the ram density and laboratory properties of the sand were determined. The effectiveness of the drying was assessed by means of the moisture gradients before and after drying, and the time for which the torch was played on the mould surface.

The results shown are for two moulds thus dried, the first one being dried in a normal way, the second mould being dried for an excessive period of time.

Properties of sand.	Mould "A."	Mould "B."
H_2O	6.0 per cent.	5.8 per cent
Permeability	180	180
Green compression	6.8 lb. per sq. in.	7.9 lb. per sq. in.
Ram density	111 lb. per cub. ft.	112 lb. per cub. ft.
Time dried	4.0 min.	6.0 min.

Moisture gradients have been drawn for the above two moulds. The gradients after drying appear to indicate that in torch dried moulds there is a region of high moisture content a short distance away from the surface of the mould. This is probably the result of using an air stream of fairly high temperature and velocity (the gas torch would give such conditions since it consists of a gas burner with its source of oxygen in the form of compressed air) to dry the mould.

An examination of the moisture gradient in the case of mould "B" shows that it was dried more effectively than moulds dried with hot air. (See Fig. 20.) However, as a result of drying it for a longer period than was thought necessary, though moisture was removed from the mould, it would have been useless from the point of view of making a casting, since the surface was cracked and had spalled and the sand had swollen to the extent of rising almost ¼ in. out of the box.

(*Conclusion at foot of next column*)

Conclusion

Gas torches can be used for the surface drying of moulds, but the operation should be carefully controlled since excessive drying can give rise to cracked and swollen moulds. It is probable that one feature of their use is a belt of high moisture content at a short distance from the surface of the mould.

Current Views on Precision Casting

Written Discussion

MR. D. F. B. TEDDS wrote to thank the Authors of the Papers on precision casting, and especially the Mond Nickel Company, Limited, for the presentation of their Papers at the Nottingham Conference. (Verbal discussion published last week.) He pointed out that it was very gratifying to be given so much detail, as in the past too much secrecy had shrouded this particular section of the foundry industry. If only more Papers had been written along the lines of this particular one, much more progress would have been made and misconceptions eliminated as to the scope and possibilities of the process.

With regard to the details appertaining to the development of the primary or spray coating, the Authors condemned sodium silicate as a binder and suggested it was the cause of the reaction between the mould face and the Nimonic 80. He suggested that this was not the case. Both silica and sillimanite were acidic in character and would react with the titanium contained in the Nimonic 80, whatever was being used for bonding media. The use of basic refractories, *e.g.*, alumina, magnesia or zirconia, bonded with sodium silicate, were quite satisfactory, no reaction taking place. It would be interesting to know what the Authors used for coating the test bars shown in Fig. 2, whether it was silica, sillimanite or zircon, bonded with sodium silicate.

Another point of interest was the defect shown in Fig. 5, stated to be probably due to entrapped air! He suggested that this "orange peel" effect was caused by poor vibrating conditions. Coarse particles of investment segregated and lay close to the pattern, the finer grades of investment failing to pack around them. When the metal was forced into the mould, the spray coating was depressed into the voids, giving the rippled finish on the surface of the resultant casting.

MR. H. EVANS, in reply, wrote to say that, in regard to the materials used for the pattern spray coating, while silica is acidic in character, sillimanite is a neutral refractory and is not, therefore, attacked by high melting point alloys containing nickel. As indicated in Fig. 2 of the Paper, the test bars shown were cast in a mould having a pattern spray made from silica flour bonded with sodium silicate. In connection with the "rippled" or "orange-peel" defect shown in Fig. 5, it should be pointed out that in their investigations on this matter, a series of tests were done to determine the effect of vibrating conditions with negative results. Even when vibrating conditions were satisfactory, checked by actually sectioning and examining finished moulds, the defect persisted and was not eliminated until attention had been given to running and venting methods.

Small Bushing with Greensand Cores

By "Tramp"

Bronze bushings, which are required in large numbers, can be made vertically without the use of dried cores by the employment of a simple stripping plate. Fig. 1, below, illustrates the method. Four patterns of the required bushing are prepared in brass, about two inches longer than the length of the desired casting. A tight brass plate is also made with four holes accurately machined to allow of the bushing patterns passing through as illustrated.

The method of moulding is:—The plate (*a*) is placed on a board (*b*) and the four patterns (*c*) positioned on the plate (*a*). Four plugs (*d*), which accurately suit the internal diameter of the bushings, are placed in them and rest upon the board (*b*). The thickness of the plugs is such as to bring their top face in line with the top of the plate (*a*) so as to make a continuous joint face in the mould.

Having prepared the patterns as described, and placed a suitable box in position, facing sand is riddled over the patterns both inside and out and the job rammed up. It is then turned over and the pieces of the patterns projecting through the plate are used to hold them steady during the withdrawal operation, the four plugs (*d*) retain the sand in the interior of the pattern and plate (*a*) in the remainder of the mould.

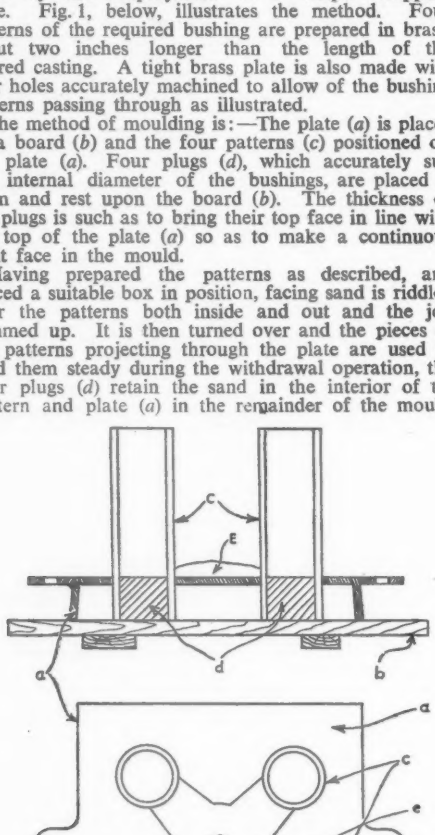

FIG. 1.—MODE OF MAKING BRONZE BUSHING.

After stripping the patterns, the plugs are removed and the plate taken away. A plain top part rammed up on a suitable plate completes the two halves of the mould which are now assembled and cast. Pattern of the runner (*e*) would of course be a part of the equipment to save the trouble of cutting them by hand and also to ensure uniformity in each mould.

Publications Received

Geelong. E. Backwell & Son Pty., Limited, stove grate makers, of 79 to 85, Gheringhap Street, Geelong, Victoria, have sent us a booklet which sets out the potentialities of Geelong as a manufacturing and residential area. It is excellently illustrated, and its only defect is that it gives no statistics. This is to be regretted, as it would be interesting to know the population, the rates, the cost of electricity and gas, and so forth. Unquestionably, it is a beautiful city, and deserves to be better known throughout the Empire—or whatever is the modern equivalent for this word.

S. and W. Magazine, Vol. I, No. 8. Issued by Smith & Wellstood, Limited, Bonnybridge, Scotland.

This issue *inter alia* reports that new mechanically controlled ventilators have been installed in the moulding shop, that Mr. F. G. Chatley and Mr. F. Kinsella, of the Liverpool office, have retired, and that the former is being replaced by Mr. T. J. Aitkin as office manager.

"Shotblast and Shells." This pamphlet, issued by H. G. Sommerfield, Limited, of 8, Camden Road, London, N.W.1, is a record of the war effort made by a comparatively small concern. Yet a contribution made by the firm to the war effort was the construction of 455 shotblast plants for treating shells. It is a very human document and tells of the destruction of the works by bombing, the search for temporary premises, and the part played by the office cat as a danger signal. The reviewer specially recommends that overseas readers should write to the issuing house for a copy, as, so far as he is aware, this is the only publication which tells just what the modest London manufacturer had to undergo during the war.

Italian Technical Translations

Campfond (Consorzio Nationale Approvigionmenti Materie Prime per Fonderie Ghisa), which appears to be assuming the rôle of the mouthpiece of the Italian foundry industry, has sent us six copies of two technical publications. Bulletin BI. translates the Council of Ironfoundry Associations' report, "Use of Ash High Coke in the Foundry," and the second, "Rotary Furnaces for Foundry Use." This has been translated from the French journal *Fonderie*. Both are neatly and attractively presented, and the impression is given that there is no acute shortage of paper in Italy.

Restrictions on Labour

Industry Approves Draft

The Joint Consultative Committee, presided over by the Minister of Labour, last week approved a draft of the general Control and Engagement Order, which is planned to come into operation on October 1 next. The draft follows closely the lines of the wartime Order, and the general effect of the Order, as before, will be that employers will not be able to engage or seek to engage by advertisement or public notice employees coming within its scope except through the Ministry of Labour, and workers must obtain their employment through the Ministry. The exceptions will presumably make it possible, as under the previous Order, for employers to fill by their own efforts most vacancies for staff above the rank of foreman or office supervisor. The proposed Order does not include part-time workers doing less than 30 hours a week.

The Committee also considered the proposed temporary increase in working hours in dollar-earning and dollar-saving industries, and in basic industries essential to the expansion of other industries. It was agreed that as a short-term policy those industries should lengthen their hours of work to the extent that was necessary and practicable, having regard to available supplies of fuel, power, and materials. Those industries with adequate supplies of coal and raw materials should be approached at once; others should be asked to increase their hours as soon as supplies permitted, and in the meantime should lose no time in working out methods of raising their production to full capacity when it became possible. It would be for each industry to plan through its established negotiating machinery the method by which an increase in hours should be secured.

The official statement after the meeting showed that the Committee felt some concern that arrangements for staggering hours to relieve the electricity load during the winter should be speeded up. The conclusion of regional and district plans was urged.

Consumption of Non-ferrous Metals

Detailed figures of consumption of non-ferrous metals in the United Kingdom during the second quarter of 1947 have been issued by the Directorate of Non-ferrous Metals. Consumption of virgin metal for the year 1946 and the first and second quarters of 1947 was as follows:—

	Total, 1946.	First quarter, 1947.	Second quarter, 1947.
	Tons.	Tons.	Tons.
Zinc	216,089	48,701	57,946
Lead	193,506	42,535	40,237
Tin	25,606	6,663	6,857
Cadmium	542	122	130
Antimony	5,023	1,160	1,317

Engineers and Government Plans

The president of the Engineering Industries Association (Lord Davidson), in a statement issued last week, says engineers will prove equal to their vital task in the nation's present crisis; but only if the Government and the nation face the facts squarely and at once will it be possible to overcome in time the dangerous threats to our economy. Production, he continues, is the key to recovery. Industry should be free, and freed, from restrictive practices. The Association will support the Government and cooperate with them in any plans that will really mean more coal, more raw materials, especially more steel and more power.

Complete support for the Government in their plans to achieve economic security was pledged in a resolution which was passed unanimously by the general council of the Confederation of Shipbuilding and Engineering Unions in Newcastle-upon-Tyne last week. The resolution said that to give effect to the smooth operation of the Government's plans and proposals, and to enable full mobilisation of the population in the task of solving the economic crisis, it was essential that immediate discussions took place with the appropriate authorities concerned to safeguard workers in regard to wages, full employment, subsistence allowances where necessary, and other matters. The council is to seek a meeting with the Prime Minister.

Engineering Companies Amalgamate

The Power-Gas Corporation, Limited, Stockton-on-Tees, and Rose, Downs & Thompson, Limited, engineers and ironfounders, of Hull, have amalgamated. A holding company—Rose, Downs Holdings, Limited—has been formed through which an interchange of capital has been arranged. Mr. L. H. Downs, managing director of Rose, Downs & Thompson, Limited, has been appointed chairman of the new company, with Mr. T. H. Kaye as a director and secretary. Representatives of the Power-Gas Corporation on the board include Mr. W. E. Rambush and Mr. R. W. Rutherford. Mr. Downs has been appointed a director of the Power-Gas Corporation.

L.M.S. Experiment with Roller Bearings

Twenty-two of the 150 new steam locomotives that are being built in L.M.S. workshops this year are to be experimentally fitted with roller bearings with the object of obtaining greater availability, a higher annual mileage, lower maintenance costs, and smoother running. While the fittings of these bearings may reduce the consumption of coal, further experiments for fuel economy are to be made with 20 locomotives fitted with the Caprotti type of poppet valve gear, 10 of which will be fitted with roller bearings, and 10 with standard plain bearings.

Company News

(Figures for previous year in brackets.)

Walker Bros.—Dividend of 7% (same).

W. N. Froy & Sons—Dividend of 12½% (10%).

Chas. Baynes—Interim dividend of 25% (same).

Herbert Terry & Sons—Interim dividend of 10% (same).

British Oxygen Company—Interim dividend of 8% (same).

G. Beaton & Son—Dividend of 10% (same and bonus of 5%).

Newman & Watson—Net profit to March 31, £15,110 (£10,949); dividend of 6% (5%); forward, £5,364 (£4,427).

Fletcher Hardware Company—Net profit for 1946, after taxation, £11,334; dividend of 10%; forward, £6,177 (£2,787).

British Electrical Resistance Company—Net profit for the year ended July 31, after taxation, etc., £8,320 (£8,809); to dividend, nil (£5,000); forward, £16,531 (£8,211).

Albert Phillips (Ireland)—Loss for 1946, £1,734 (£424); deducting credit balance brought in £6 and reserves no longer required transferred to profit and loss, £1,246, leaving debit forward, £482.

Newton Bros. (Derby)—Net profit for the year ended March 31, after depreciation, taxation, etc., £16,047 (£14,759); to reserve, £4,480 (£5,000); dividend of 17½% and bonus of 7½% (same); forward, £9,173 (£8,468).

Warner & Company—Net profit to June 30, £7,681 (£4,193); to general reserve, £3,000 (contingencies reserve, £1,000); final dividend of 5% (same) and bonus of 5% (nil), making 12½% (7½%); forward, £4,674 (£4,228).

Belliss & Morcom—Net profit for the year ended March 31, after depreciation, taxation, etc., £55,683 (£55,360); to pensions, £130,000 (nil); final dividend of 10%, making 14% (same); forward, £50,940 (£174,542).

Bairds & Scottish Steel—Profit for 1946, including income from investments, and after providing for tax, depreciation, contingencies, and directors' fees, £151,270 (£103,241); dividend of 10% (6%); forward, £125,011 (£100,791).

Nico Light Engineering Company—Net profit for the year ended March 31, after depreciation, taxation, etc., £9,164 (£4,695); to reserve, £3,000 (nil); dividend of 10% (7½%) and bonus of 5% (same), making 15% (12½%); forward, £7,182 (£5,483).

John Howden & Company—Net profit for the year ended April 30, £257,932 (£180,554); to tax, £185,000 (£133,900); general reserve, £30,000 (£15,000); deferred repairs, nil (£7,850); final dividend of 22½%, making 30% (first and final of 17½%); forward, £34,454 (£30,792).

Dawnays—Net profit for the year ended March 31, after depreciation, directors' fees, taxation, etc., £43,068 (£47,135); written off goodwill, £31,921 (nil); reserve for employees' pensions, £10,000 (nil); final dividend of 12½%, making 20% (25%, including bonus of 5%); forward, £179,381 (£206,163).

John Lysaght—Net profit for 1946, £512,479 (£508,168); to depreciation and obsolescence, £210,000 (£150,000); surplus taxation reserves not required, £60,133 (nil); dividends from associated companies not applicable to 1946, £6,968; dividend of 22½%, less tax (15%, tax free); forward, £434,032 (£331,752).

Wolverhampton Metal Company—Net profit for the year ended March 31, after tax, £45,031 (£37,616); E.P.T. and profits tax, £24,000 (£5,000); income tax, £28,000 (£23,400); to dividend equalisation reserve, £5,000 (nil); final dividend of 15% and bonus of 10%, making 40% (30%); forward, £43,008 (£36,606).

Fairbairn Lawson Combe Barbour—Net profit for the year ended March 31, after depreciation, taxation, etc., £58,953 (£57,251); taxation over-provided in previous years and income tax on initial allowances, £50,000 (nil); dividends from subsidiaries, £19,586 (nil); dividend of 35% (25%); forward, £306,096 (£205,165).

Manley & Regulus—Trading, etc., profit to April 30, £99,131 (£45,045); to directors' fees, £500 (same); maintenance and depreciation, £11,955 (£11,327); deferred repairs, £10,000 (nil); tax, £41,952 (£4,388); final dividend of 10% (same) and bonus of 10% (5%), making 25% (20%); forward, £67,466 (£51,045).

Electrical Switchgear & Associated Manufacturers—Loan interest from subsidiary company for the year ended March 31, £3,167 (£35,550); fees, £2 (£1); net profit, after tax, £1,143 (£15,837); directors' fees, £600 (same) and administration expenses £27 (same), £1,399 (£19,087); no dividend is recommended (20%); forward, £15,614 (£17,378).

Bromilow & Edwards—Trading profit for the year ended March 31, after expenses, £24,208 (£67,819); to directors' fees, £1,400 (same); depreciation, £6,562 (£4,017); provision for taxation, including 1947-8 income tax, £6,000 (£22,750); war contingencies, nil (£22,710); net profit, £10,246 (£16,942); to general reserve, £2,500 (£10,000); dividend of 10% (same) and bonus of 2½% (same); forward, £430 (£246).

Mellowes & Company—Net profit for 1946, after depreciation, etc., £76,602 (£83,536); to directors' bonus, £1,957 (£1,793); reserve for taxation, £36,000 (same); employees' pension fund, £2,500 (same); special depreciation of buildings, nil (£8,000); reserve for equalisation of dividends, nil (£15,000); final dividend of 10% and bonus of 10%, making 30% (same), the final dividend and the bonus being on larger capital; forward, £18,865 (£7,241).

Christy Bros. & Company—Trading profit for the year ended March 31, £117,375 (£64,789); general expenses, etc., £35,096 (£27,363); depreciation, £538 (£521); net profit, £81,741 (£36,905); dividends and interest on investments, £26,798 (£30,126); to tax, £44,937 (£22,308); interest on loans, £865 (£374); employees' superannuation, £5,000 (£2,000); general re-

serve, £5,000 (same); directors' and employees' bonuses, £18,750 (same); dividend of 17½% (same); forward, £41,862 (£24,788).

Aron Electricity Meter—Trading profit for the year ended March 31, £62,666 (loss £22,093); fees and sundry income, £43 (£749); E.P.T. repayment, £62,576; directors' fees, £2,238 (£2,268); expenses, £5,887 (£6,025); legal fees, £1,418 (£1,366); E.P.T., £6,600 (nil); patents, £184 (£177); staff pensions, £1,616 (£1,542); interest, £7 (same); war damage, nil (£742); net profit, £44,759 (£29,105); to tax, £25,937 (£16,542); general reserve, £5,000 (nil); dividend of 15% (10%); forward, £23,244 (£21,957).

Textile Machinery Makers—Dividends receivable from subsidiary companies for 1946, £105,295 (£376,055); E.P.T. recoverable, £103,495 (nil); to general expenses, £31,823 (£31,443); directors' fees, £4,472 (£16,324); loan interest, £249 (nil); Indian taxation, nil (£42); E.P.T., nil (£604); income tax, £79,519 (£164,231); net profit, £103,717 (£167,771); to under-provision for taxation in previous years, £12,122 (nil); preference dividends, £25,286 (£22,988); ordinary dividend of 6% (same); forward, £117,749 (£135,243).

Revo Electric Company—Profit for the year ended March 31, after depreciation, £404,928 (£279,221); adjustment of contracts for 1946, £24,333 (nil); registration fees, £42 (£38); to taxation, £262,662 (£196,616); directors' fees, £2,000 (same); pensions and assurance, £3,190 (£3,423); auxiliary power plant, £30,000 (nil); net profit, £217,331 (£160,386); to general reserve, £50,000 (£25,000); stock contingencies, £20,000 (£10,000); final dividend of 12½% and bonus of 10%, making 27½% (20%); forward, £91,746 (£85,880).

Consett Iron Company—Trading profit, before depreciation, for the year ended March 31, £1,146,547 (£1,126,612); other income, £50,262 (£63,791); to directors' fees, £8,000 (same); debenture interest, £48,785 (£50,410); depreciation, £125,000 (same); taxation, £375,000 (£525,000); net profit, £640,024 (£481,993); to debenture sinking fund, £40,609 (£39,270); plant improvement and extension reserve, £400,000 (£225,000); preference dividend, £22,000 (£21,000); final ordinary dividend of 10%, making 12½% (10%); forward, £240,392 (£255,477).

Guest Keen Baldwins Iron & Steel Company—Trading profit for 1946, £1,577,824 (£1,308,208); dividend from a subsidiary, £24,314 (£16,476); miscellaneous income, etc., £7,960 (£11,840); depreciation, £375,000 (same); additional depreciation, £90,000 (nil); deferred repairs, nil (£50,000); debenture interest, £81,612 (£82,800); debenture redemption, £30,888 (£29,700); E.P.T. on 1946 profit, £423,000 (£186,000); income tax, 1947-48, £277,000 (£351,000); directors' fees, £6,167 (£6,500); net profit, £326,431 (£255,524); interest and redemption, £36,360 (same); dividend, £42,958 (£39,052); ordinary dividend of 10% (7½%); forward, £199,927 (£154,939).

Guest, Keen & Nettlefolds—Trading profit for the year ended March 31, after E.P.T. and profits tax, £1,520,297 (£1,203,990); dividends and interest on the company's shareholding, debenture and income notes in subsidiary companies, £777,032 (£678,046); dividends and interest on other investments, £83,460 (£55,758); miscellaneous income, £26,654 (£26,013); to depreciation and obsolescence, £400,000 (£320,000); debenture interest, £47,028 (£48,925); income tax, £575,000 (£450,000); net profit, £1,385,415 (£1,144,882); provision for debenture redemption, transferred to general reserve, £44,845 (£42,548); general reserve, £150,000 (same); transfer to general reserve (income not applicable to the year), £472,906 (£100,000); preference dividends, £327,880; final ordinary dividend of 7%, making 11% (same); forward, £1,312,919 (£996,333).

New Companies

("Limited" is understood. Figures indicate capital. Names are of directors unless otherwise stated. Information compiled by Jordan & Sons, 116, Chancery Lane, London, W.C.2.)

Ekem Engineering, 11, Andover Place, London, N.W.6—£1,000.

Fraser Hydraulic Transmission Company, 68, Regent Street, Liverpool—£10,000. W. Fraser.

Hurcal Engineering Company, Pye Road, Heswall, Ches—£1,000. S. B. Caldwell and E. Hurley.

A. Cockburn & Company (Engineers), 25, Gateside Street, Glasgow—£20,000. A. and T. O'Beirne.

Mitchell Engineering Group, 1, Bedford Square, London, W.C.—£10,000. F. G. and E. B. N. Mitchell.

Wilson (Engineers Newcastle), 44, Dean Street, Newcastle-upon-Tyne—£3,000. S. Wilson and J. M. Sinton.

Attewell Engineering Company, Devonshire Buildings, Bath—£10,000. K. E. Langley and A. H. Butler.

Feltham Scientific Equipment, St. Albans Farm, Staines Road, Feltham—£2,500. L. P. Goddard and J. Park.

Kindbergs, Vulcan Terrace, The Docks, West Hartlepool—Shipbuilders, etc. £5,000. H. S. and S. B. Grace.

Donald Cowan & Company, River Road. Barking, Essex—Agricultural engineers. £3,100. D., P., and K. Cowan.

Taylor & Son (Swinton), Don Foundry, Swinton, Mexborough, Yorks—Ironfounders. £7,000. W. and J. Taylor.

Murray Mackie, 26, Queen Street, Glasgow.—Engineers. £6,000. A. M. and F. M. Mackie, and E. S. Patterson.

E. T. Engineering, Oak Works, Oak Road, Harold Wood, Essex—£5,000. W. J. Edmondson and H. A. Turbefield.

Pallets, 39, St. James's Street, Westminster, London, S.W.1—Mechanical, electrical and general engineers, etc. £5,000.

Northampton & Midland Plating Company—£5,000. T. B. Wingell, 42, Charles Street, Northampton, and G. N. Wingell.

Vab Plating Company, 89, Kingsway, London, W.C.2—£10,000. A. H. Redfern, B. C. Gotelee, I. Lloyd, and C. W. Parker.

Guest, Keen & Nettlefolds' Prospects

Importance of the Finished Article

Sir S. R. Beale, chairman of Guest, Keen & Nettlefolds, Limited, in his statement circulated with the annual accounts, says that the position of their own group of companies is a good example of the desirability of proceeding to such further supervision of the industry as may be found necessary in the national interest by way of evolutionary development of the functions of the Steel Board. Their chief interest lies in the finishing ends of the industry. They are only interested in steel manufactured through certain of their allied companies. Similar relationships exist elsewhere, he says, developed out of practical need, and supported by continued scientific research controlling manufacturing processes from the raw material to the finished article. It is this finished article that commands the most remunerative price to the country in the export markets of the world, and it would be disastrous to hamper improvement and development in any way.

Referring to their associated companies, the chairman points out that John Lysaght, Limited, have been particularly handicapped by shortages of fuel and labour and the severe weather earlier in the year. Apart from their own domestic problems, John Lysaght, Limited, found their development policy affected by the general policy of the industry in respect of the strip mill proposals for South Wales, because of the fact that they owned a 3-stand 4-high cold-reduction mill fully capable of cold reducing the wide sheet product of the proposed new hot mill. When it became clear that expert opinion inclined to the definite opinion that joint ownership of the hot and cold mills was essential for efficient operation, they decided that they must conform to this opinion, and agreed that the assets of John Lysaght's Newport Works should pass to the new company. The Margam and Port Talbot Works of Guest Keen Baldwins also pass to the Steel Company of Wales, but not the steelworks and rolling mills at Cardiff. whose output flows mainly to their own works.

In Australia, Sir S. R. Beale continues, Lysaghts have still further extended their interests by completing arrangements with the American Rolling Mill Company, who were their partners in a venture for the provision of high-grade steel sheets, known as Commonwealth Rolling Mill Company, for the purchase of their interests in that company. John Lysaght's share in the plan of development for the steel industry in England includes, at Scunthorpe, the provision of further blast furnaces, enlarged steel furnaces, coke ovens, and a modernisation of their rolling mill. It is the board's intention to negotiate a special loan for this expenditure.

SIR JAMES LAING & SONS, LIMITED, Sunderland, are to lay the keel of a 16,000-ton tanker for the British Tanker Company, Limited, which will be the biggest ship ever built on the Wear. In 1950, however, a 22,000-ton ship will be launched from the same berth, which is 550 ft. long and was built during the war.

Personal

SIR FRANCIS JOSEPH has resigned from the board of the Birmingham Small Arms Company, Limited.

MR. J. PATON and MR. A. S. MCNAUGHT have been appointed directors of P. & W. Maclellan & Company, Limited, structural engineers, etc., of Glasgow.

MR. H. F. OSBORNE, formerly production manager, has been appointed general manager of Vokes, Limited, filtration and silencing engineers, of Putney, London, S.W.15.

SIR GEOFFREY K. PETO and MR. C. W. SPIERS have retired from the board of the Morgan Crucible Company, Limited. MR. J. WALKER has been appointed a director.

MR. A. STATHAM has resigned from the board of Banister, Walton & Company, Limited, structural engineers, etc., of Trafford Park, Manchester. MR. G. WRIGHT and MR. T. R. FLETCHER have been appointed directors.

MR. A. R. MELLER, assistant managing director of the Motherwell Bridge & Engineering Company, Limited, is at present on a tour of the Middle East countries. He is inspecting sites where his company has contracts on hand or in prospect.

MR. HENRY BURNS is leaving the head office of Thos. W. Ward, Limited, Sheffield, to open and take charge of a new office in New Zealand. He will be responsible for the complete representation of Thos. W. Ward's interests in New Zealand and also for certain of their associated and subsidiary companies.

MR. P. GOOD has been elected president of the Institution of Electrical Engineers for 1947-48. MR. D. B. HOSEASON has been elected a vice-president, MR. E. LEETE hon. treasurer, and MR. C. M. COCK, MR. T. E. GOLDUP, MR. H. L. KIRKE, and MR. J. S. PICKLES ordinary members of Council, together with MR. J. M. FERGUSON as an associate member.

MR. S. THOMSON, a director and manager of the Lanarkshire Steel Company, Limited, and MR. JAMES GIBSON, manager of the Glengarnock Steel Works, have been appointed executive directors of Colvilles, Limited. The management of the Dalzell and Lanarkshire Steel Works is to be co-ordinated and Mr. Thomson has been appointed general manager over both works.

Wills

BROADBENT, HERBERT, of East Brierley, Yorks, retired ironfounder £2,946

RUSSELL, G. S., of Erdington, area manager of W. & T. Avery, Limited £6,722

DENNIS, J. D., of Grassington, Yorks, partner in Millar, Dennis & Company, brassfounders, etc., of Bradford £17,903

OGLE, E. J., of Handsworth, Birmingham, for 34 years engineer surveyor to the British Engine Insurance Company, Limited £3,010

WARING, J. E., of Redhill, Castleford, Yorks, a director of Henry Berry & Company, Limited, hydraulic engineers, of Leeds £38,640

BATCHELOR, T. C., of Leamington Spa, managing director of Latch & Batchelor, Limited, wire and wire-rope manufacturers, of Birmingham £583,088

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News in Brief

WINNERS OF THE Briddon cup at a works fire brigade competition at Park Gate recently were a team from the Park Gate Iron & Steel Company, Limited.

PLANS HAVE BEEN APPROVED for the erection of a brassfoundry for the Sunderland Forge & Engineering Company, Limited, which is part of a large reconstruction scheme.

RICHARD SUTCLIFFE, LIMITED, Horbury, Yorks, are taking over Ossett Corporation Gasworks' retort house, together with other buildings, until recently occupied by the Admiralty as a naval stores.

NEWMAN & WATSON, LIMITED, sanitary engineers, intend to increase their capital and make an offer to shareholders when the times seem most favourable, says Mr. B. W. Mason, the chairman, in his address to shareholders.

SIR DONALD COLEMAN BAILEY, inventor of the wartime Bailey bridge, has been recommended for an award of £12,000 by the Royal Commission on awards to inventors. He is superintendent of the Ministry of Supply experimental bridging establishment.

EIGHT WOMEN have started work as welders at the yard of the Blyth Dry Docks Shipbuilding Company, Limited. They are the first of a limited number of women to be employed by the company in manual jobs, and the first women to be started since the war ended.

THE POWER-GAS CORPORATION, LIMITED, have received from Holland a further £500,000 contract for a chemical fertiliser plant similar to that which they have already on hand for the State mines of the Dutch Government. The company's commitments in Holland now exceed £1,000,000.

INTERNATIONAL TWIST DRILL, LIMITED, have received Treasury consent for a further issue of shares. It is proposed to issue 353,334 ordinary 1s. shares, the balance of the authorised capital, to shareholders registered on August 8 at a price of 10s. 6d. per share in the proportion of one new share for every two held.

THE SHEFFIELD TWIST DRILL & STEEL COMPANY has been registered as a private company, with a nominal capital of £100 in 4s. shares, to acquire a business of the same name incorporated in 1915. It is understood that the company will be converted into a public concern and will make an issue of shares in the near future.

IMPORTS OF iron and steel into Eire in April last were as follow:—Pig-iron, 55 tons, valued at £7,278, against 650 tons, valued at £7,031 in April, 1946; iron bars and rods, 23 tons (£784), against 42 tons (£1,454); steel bars and rods, 1,075 tons (£31,496), against 811 tons (£20,956); iron and steel squares and flats, 319 tons (£10,699), against 680 tons (£17,602).

OPENED LESS THAN 12 months ago, the factory at Stockton-on-Tees, belonging to R.G. Le Tourneau (Great Britain), Limited, is to be closed down, owing to conditions experienced by the firm both in this country and in America, which have made it necessary to adopt a policy of financial retrenchment. Heavy earth-moving equipment was manufactured at the factory.

APPLICATION IS TO be made to the Council of the London Stock Exchange for quotation for the whole of the issued preference shares of B. O. Morris, Limited, manufacturers of flexible shaft and grinding machines, of Birmingham. Snell, Lovell & Company have agreed to subscribe for the whole of the issued preference shares—namely, £150,000 5 per cent. cumulative preference shares of £1 each—at 21s. 6d. per share.

VICKERS-ARMSTRONGS, LIMITED, have acquired the sole manufacturing and selling rights in this and other countries of the Scott high-speed rotary newspaper printing press and other presses from Walter Scott & Company, Inc., one of the largest manufacturers of rotary newspaper presses in the United States. The presses will be known as the Scott-Vickers press and will be made at Vickers-Armstrongs' works at Newcastle-upon-Tyne.

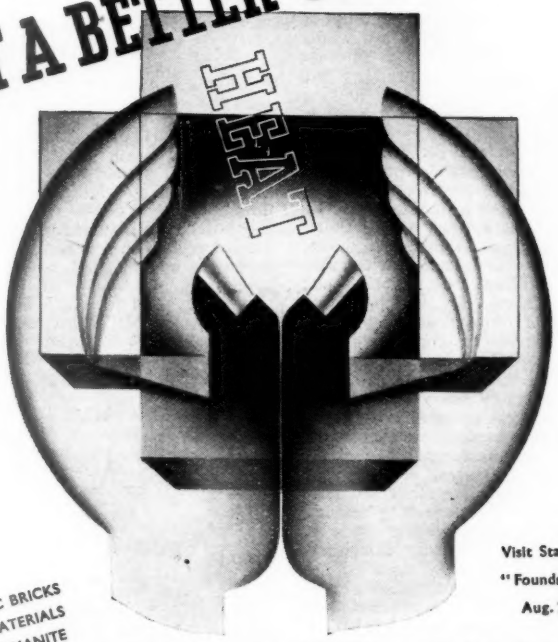
CHROMIC ACID is in short supply, and a technical note on its conservation has been prepared by the Metal Finishing Committee of the Ministry of Supply. Copies may be obtained on application to the Secretary of the Committee, c/o W.R.(D)2, Room 1033, Shell Mex House, Strand, London, W.C.2. Inquirers should ask for Supplement to E.T.A.C. Technical Memorandum No. 1, "Conservation of Chromic Acid during Periods of Shortage."

IN PURSUANCE OF Section 127 of the Factories Act, 1937, the Minister of Labour and National Service has made an Order (S.R. & O., 1947, No. 1672, price 1d.), entitled "The Fees of Examining Surgeons Order, 1947," determining the scales of fees payable by the occupier of a factory to examining surgeons for various services under the Act. The new Order comes into force on October 1 next, and provides for increases in the rates laid down.

ASHMORE, BENSON, PEASE & COMPANY, LIMITED, Stockton-on-Tees, are constructing the first blast furnace rated at 1,000 tons a day production in this country. The furnace is the first of two to be built for the Steel Company of Wales, Limited. Since the war the company have built, or are building, 10 blast furnaces with a total capacity of about 2,000,000 tons of pig-iron a year. They have contracts in hand exceeding £2,000,000 in value, at least half of which are for overseas.

TRADE VISITORS TO the Enterprise Scotland Exhibition, which opens in Edinburgh next month, will enjoy the facility of a private view of the exhibition every morning for one hour before the general public is admitted. A trained staff with expert knowledge of the different sections will be in attendance to answer questions and arrange contacts with the manufacturers in whose goods they are interested. Industrial experts from the staff of the Central Committee of Scottish Chambers of Commerce will also be available, supported by a team of interpreters.

GET A BETTER GRIP OF HEAT



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Raw Material Markets

Iron and Steel

Supplies of foundry coke according to the summer schedule are coming through up to the tonnage allocations. This will allow ironfoundries to put aside any tonnage over and above current requirements to form a stock which will serve them in good stead in the winter months. The foundries also are building up stocks of limestone and ganister. Supplies last winter were interrupted on many occasions through shortage of wagons and railway embargoes, as well as bad weather conditions. Foundries, therefore, are looking ahead. Unfortunately, it is not possible for them to do very much in respect to pig-iron. Foundry pig-iron licences cover only a tonnage for two months ahead, and the licensed quantities, owing to the scarcity of pig-iron, practically cover only current needs, leaving little or no margin to put into reserve.

Most kinds of iron are in short supply, but the shortage is particularly emphasised in the high-phosphorus pig-iron used by the light foundry trade. It is much to be hoped that shortly sufficient fuel will be found to enable additional furnaces to be put into operation, and thus provide more foundry pig-iron, although it is feared that particular emphasis will be given to basic pig-iron, in order to increase the output of steel, which is in even shorter supply than iron.

All foundries have exceptionally heavy order books. The light foundry trade has many months' work ahead of it for the housing programmes, as well as many other contracts from the manufacturers of cooking, heating and other domestic appliances. The general engineering, speciality and jobbing foundries are particularly active, as there is a very far-reaching demand for high-duty castings from large engineering concerns, including heavy tonnages in the priority categories, which must have preference. These foundries are having to use various kinds of pig-iron, because it is not possible always to get precisely the type of iron they have been in the habit of using, and which they prefer. They are consuming low- and medium-phosphorus pig-iron in considerable quantities, together with refined pig-iron and hematite. There should, in a few weeks' time, be more refined iron available, in view of the fact that export of this type of iron has now come to a standstill.

In addition to pig-iron, the requirements of the foundry trade in scrap are considerable. The engineering foundries want both cast-iron and steel scrap, but in recent weeks the flow of supplies has not been at all good, and many foundries are now in urgent need of tonnage. Most foundries, too, are handicapped through the lack of suitable skilled labour.

There cannot be any easing of the situation at the steelworks for a long time to come. Already they have booked specifications covering their outputs beyond the close of this year. Week by week the tonnage specified for priority contracts is expanding. A fair tonnage also has to be allocated to the shipbuilding industry, and yet there are a thousand and one consumers of steel plates, joists and sections not in the priority classes, pressing strongly for supplies. Most structural engineers are worried about the shortage of supplies, but it is feared that nothing can be done about it just yet. The demands from the collieries for roofing bars, rails, props and arches are considerable, as in some districts workings are being extended, thus stepping up the total requirements of steel for underground use.

Non-ferrous Metals

United Kingdom usage of copper is at a relatively high rate, despite the price of the metal in this country compared with the level ruling for overseas buyers. The monthly figures issued by the British Non-ferrous Metals Federation show that consumption of copper in the United Kingdom is well above the pre-war average, and, providing that the reduction in imports does not affect non-ferrous metals—and there is no suggestion, so far, that raw materials for the fabricating industries will be limited in any way—the present economic crisis should not affect the consumption of copper.

It is reported from Kuala Lumpur that the annual report of the Chief Inspector of Mines, Malayan Union, which has just been issued, indicates the extent of the expected recovery of the Malayan tin industry in the estimated production for 1947 and the next two years.

The target for 1947 is 46,150 tons; 1948, 72,800 tons; and 1949, 73,500 tons. Although the 1946 estimate of 12,300 tons fell short by about 4,000 tons, the report states that tin production is expected to be well on its way towards reaching its target by the end of 1947.

New Trade Marks

The following applications to register trade marks appear in the "Trade Marks Journal":—

"ALUMASC"—Aluminium hollow-ware. ALUMASC, LIMITED, 37, Lime Street, London, E.C.3.

"HOMER" (DEVICE)—Engines. GODFREY HOLMES, LIMITED, Lincoln Road, Wragby, Lincoln.

"ALITIM"—Metal rails. DOUGLAS BEAUMONT REA, 8, Cator Road, Sydenham, London, S.E.26.

"LEGG"—Transformers, etc. LEGG (INDUSTRIES), LIMITED, Williamson Street, Wolverhampton.

"ZELEC"—Pipes and tubes, sprihgs, etc. ZERO ELECTRIC, LIMITED, 85-86, Ablewell Street, Walsall.

"PENNINE"—Metal links for chain belts. PENNINE CHAINBELT COMPANY, LIMITED, Armley, Leeds.

"AFECO"—Metal clips and clamps. E. ALLMAN & COMPANY, LIMITED, 115, The Hornet, Chichester.

"RAYDOWN"—Electrical apparatus. MC & B HEAT CONTROL, LIMITED, 89, High Street, Epping, Essex.

"PANOMATIC"—Footwear machines. RALPHS ENGINEERING COMPANY, LIMITED, Crafton Street, Leicester.

"BREEZE"—Electric generating apparatus, etc. THE PLESSEY COMPANY, LIMITED, 56, Vicarage Lane, Ilford.

"WHITES-NUNAN"—Fire nozzles. WHITES-NUNAN, LIMITED, 103, Church Street, Pendleton, Salford, Lanc